

Application No. 10/727,353

Filed: December 3, 2003

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AMENDMENTS TO THE CLAIMS

1. (currently amended) A material unit transfer apparatus for moving ~~at least one~~ a plurality of material unit units between transport equipment and ~~at least one~~ a plurality of material unit storage locationlocations, for use in an automated material handling system, the apparatus comprising:

a first substantially planar platform configured to hold at least two material units;

a first transfer mechanism operatively coupled to the first platform, said first transfer mechanism being and configured and operable to move one or more material units between the first platform and the transport equipment or the storage ~~location~~locations ~~along in a direction of a first axis~~; and

a second transfer mechanism operatively coupled to the first platform, said second transfer mechanism being and configured and operable to move one or more material units between the first platform and a second substantially planar platform adjacent the first platform ~~along in a direction of a second axis~~, the second axis being disposed at substantially a right angle to the first axis,

wherein said second transfer mechanism includes at least two second transfer sub-mechanisms, each of said at least two second

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transfer sub-mechanisms being configured to operate independent of the other second transfer sub-mechanism to move a respective one of said one or more material units between the first and second platforms.

2. (currently amended) The material unit transfer apparatus of claim 1 wherein the first transfer mechanism includes at least one elongated member configured to translate in a direction parallel ~~to~~ of the first axis for accessing one or more material units directly from the transport equipment or the storage location.

3. (currently amended) The material unit transfer apparatus of claim 2 wherein the first transfer mechanism further includes a first drive mechanism configured to drive the at least one elongated member while the elongated member translates in a direction ~~parallel to~~ of the first axis.

4. (original) The material unit transfer apparatus of claim 1 wherein the first transfer mechanism includes two elongated members operatively coupled to the first substantially planar platform near opposing edges of the first platform.

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5. (currently amended) The material unit transfer apparatus of claim 4 wherein the two elongated members are configured to translate simultaneously in a direction ~~parallel to~~ of the first axis for accessing one or more material units directly from the transport equipment or the storage location.

6. (currently amended) The material unit transfer apparatus of claim 4 wherein the first transfer mechanism further includes a first drive mechanism configured to drive the two elongated members while the elongated members translate in a direction ~~parallel to~~ of the first axis.

7. (original) The material unit transfer apparatus of claim 1 wherein the second transfer mechanism includes at least one roller assembly.

8. (currently amended) The material unit transfer apparatus of claim 7 wherein the second transfer mechanism includes a plurality of roller assemblies, each roller assembly being configured to move a respective material unit between the first platform and the second platform in a direction ~~parallel to~~ of the second axis.

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9. (original) The material unit transfer apparatus of claim 8 wherein the second platform is included in a second material unit transfer apparatus configured to move at least one material unit between the transport equipment and at least one material unit storage location.

10. (original) The material unit transfer apparatus of claim 8 wherein the plurality of roller assemblies is configured to move simultaneously the respective material units between the first and second platforms.

11. (original) The material unit transfer apparatus of claim 10 wherein the second platform is included in a second material unit transfer apparatus configured to move at least one material unit between the transport equipment and at least one material unit storage location.

12. (currently amended) The material unit transfer apparatus of claim 1 further including a third transfer mechanism configured and operable to lift-move one or more material units along in a direction of a third axis disposed at substantially right angles to the first and second axes,

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wherein said third transfer mechanism includes at least two third transfer sub-mechanisms, each of said at least two third transfer sub-mechanisms being configured to operate independent of the other third transfer sub-mechanism to move a respective one of said one or more material units in a direction of the third axis.

13. (currently amended) The material unit transfer apparatus of claim 12 wherein each of said at least two third transfer sub-mechanisms comprises a respective ~~the third transfer mechanism~~ includes a plurality of lift assemblies~~assembly~~, each respective lift assembly being configured and operable to lift said respective one of said one or more material units from a selected one of the first platform and the transport equipment or the storage locations in a direction ~~parallel to~~ of the third axis.

14. (original) The material unit transfer apparatus of claim 1 wherein the material unit comprises a cassette pod.

15. (original) The material unit transfer apparatus of claim 14 wherein the cassette pod comprises a front opening unified pod.

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16. (original) The material unit transfer apparatus of claim 1 wherein the transport equipment is selected from the group consisting of a conveyor and an overhead hoist transport vehicle.

17. (original) The material unit transfer apparatus of claim 1 wherein the at least one material unit storage location is disposed in a storage unit selected from the group consisting of a stocker and a vertical carousel storage unit.

18. (original) The material unit transfer apparatus of claim 1 wherein the at least one material unit storage location is disposed on one or more fixed shelves.

19. (currently amended) An automated material handling system, comprising:

one or more storage locations, each storage location being configured to hold at least one material unit;

transport equipment configured to move one or more material units between a plurality of predetermined sites; and

a material unit transfer assembly for moving one or more material units between the transport equipment and the one or more storage locations, the material unit transfer assembly including a

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plurality of material unit transfer apparatuses, each material unit transfer apparatus as recited in claim 1,

the plurality of material unit transfer apparatuses being arranged side-by-side within a plane defined by first and second orthogonal axes to allow a first transfer mechanism included in each apparatus to move along-in a direction of the first axis at least one material unit between the respective apparatus and at least one storage location or the transport equipment, and to allow a second transfer mechanism included in each apparatus to move along-in a direction of the second axis at least one material unit between the respective apparatus and an adjacent material unit transfer apparatus within the assembly.

20. (currently amended) The system of claim 19 wherein the first transfer mechanism of each material unit transfer apparatus includes at least one elongated member configured to translate along-in a direction of the first axis for accessing the at least one material unit directly from the storage location or the transport equipment, the material unit transfer assembly further including a common drive mechanism configured for simultaneously driving the at least one elongated member of the respective material unit transfer apparatus.

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21. (original) The system of claim 19 wherein the material unit comprises a cassette pod.

22. (original) The system of claim 21 wherein the cassette pod comprises a front opening unified pod.

23. (original) The system of claim 19 wherein the transport equipment is selected from the group consisting of a conveyor and an overhead hoist transport vehicle.

24. (original) The system of claim 19 wherein the one or more material unit storage locations are disposed in a storage unit selected from the group consisting of a stocker and a vertical carousel storage unit.

25. (original) The system of claim 19 wherein the one or more material unit storage locations are disposed on one or more fixed shelves.

26. (original) The system of claim 19 wherein the transport equipment and each material unit transfer apparatus has at least

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one location associated therewith for holding at least one material unit, and further including

a plurality of sensors configured to detect the presence of respective material units in each storage location and in each location associated with the transport equipment and the material unit transfer apparatuses, and to provide signals indicative of whether a respective material unit is present in each of the locations, and

a controller operative to receive the signals provided by the sensors and to control the movement of the material units based on the received sensor signals.

27. (original) The system of claim 26 wherein the controller is further operative to maintain a database indicating whether a respective material unit is present in each storage location and in each location associated with the transport equipment and the material unit transfer apparatuses.

28. (withdrawn) A method of operating a material unit transfer apparatus for moving at least one material unit between transport equipment and at least one material unit storage location, for use

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in conjunction with an automated material handling system, comprising the steps of:

moving one or more material units between a first substantially planar platform and the transport equipment or the storage location along a first axis by a first transfer mechanism, the first platform and the first transfer mechanism being included in the material unit transfer apparatus; and

moving one or more material units between the first platform and a second substantially planar platform adjacent the first platform along a second axis by a second transfer mechanism included in the material unit transfer apparatus, the second axis being disposed at substantially a right angle to the first axis.

29. (withdrawn) The method of claim 28 wherein the first moving step includes translating at least one elongated member along the first axis for accessing the one or more material units directly from the transport equipment or the storage location, the elongated member being included in the first transfer mechanism.

30. (withdrawn) The method of claim 29 wherein the first moving step further includes driving the at least one elongated member

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while the elongated member translates along the first axis by a first drive mechanism included in the first transfer mechanism.

31. (withdrawn) The method of claim 28 wherein the first moving step includes translating simultaneously two elongated members in a direction parallel to the first axis for accessing the one or more material units directly from the transport equipment or the storage location, the two elongated members being included in the first transfer mechanism.

32. (withdrawn) The method of claim 31 wherein the first moving step includes driving the two elongated members while the elongated members translate in a direction parallel to the first axis by a first drive mechanism included in the first transfer mechanism.

33. (withdrawn) The method of claim 28 wherein the second moving step includes moving one or more material units between the first platform and the second platform in a direction parallel to the second axis by at least one roller assembly included in the second transfer mechanism.

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34. (withdrawn) The method of claim 33 wherein the second platform is included in a second material unit transfer apparatus for moving at least one material unit between the transport equipment and at least one material unit storage location.

35. (withdrawn) The method of claim 33 wherein the second moving step includes simultaneously moving respective material units between the first and second platforms by two roller assemblies included in the second transfer mechanism.

36. (withdrawn) The method of claim 35 wherein the second platform is included in a second material unit transfer apparatus for moving at least one material unit between the transport equipment and at least one material unit storage location.

37. (withdrawn) The method of claim 28 further including the step of lifting one or more material units along a third axis disposed at substantially right angles to the first and second axes by a third transfer mechanism included in the material unit transfer apparatus.

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38. (withdrawn) The method of claim 37 wherein the lifting step includes lifting respective material units in a direction parallel to the third axis by a plurality of lift assemblies included in the third transfer mechanism.

39. (withdrawn) The method of claim 28 wherein the first moving step includes extracting a plurality of material units simultaneously from the storage location for subsequent transfer to the first platform.

40. (withdrawn) The method of claim 28 wherein the storage location includes first and second sub-locations, and wherein the first moving step includes extracting a first material unit from the first sub-location for subsequent transfer to a distal end of the first platform, the first sub-location being disposed between the first platform and the second sub-location.

41. (withdrawn) The method of claim 28 wherein the storage location includes first and second sub-locations, and wherein the first moving step includes extracting a second material unit from the second sub-location for subsequent transfer to a proximal end

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of the first platform, the first sub-location being disposed between the first platform and the second sub-location.

42. (withdrawn) The method of claim 28 wherein the first moving step includes moving a plurality of material units simultaneously from the first platform to the transport equipment or the storage location.

43. (withdrawn) The method of claim 28 wherein the storage location includes first and second sub-locations, and wherein the first moving step includes moving a first material unit from a distal end of the first platform to the first sub-location, the first sub-location being disposed between the first platform and the second sub-location.

44. (withdrawn) The method of claim 28 wherein the storage location includes first and second sub-locations, and wherein the first moving step includes moving a first material unit from a proximal end of the first platform to the first sub-location, the first sub-location being disposed between the first platform and the second sub-location.

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45. (withdrawn) The method of claim 28 wherein the storage location includes first and second sub-locations, and wherein the first moving step includes moving a second material unit from a proximal end of the first platform to the second sub-location, the first sub-location being disposed between the first platform and the second sub-location.

46. (withdrawn) The method of claim 28 wherein the storage location includes first and second sub-locations, and wherein the first moving step includes moving a first material unit from the first sub-location to the second sub-location, the first sub-location being disposed between the first platform and the second sub-location.

47. (withdrawn) The method of claim 28 wherein the storage location includes first and second sub-locations, and wherein the first moving step includes moving a second material unit from the second sub-location to the first sub-location, the first sub-location being disposed between the first platform and the second sub-location.

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48. (withdrawn) The method of claim 28 wherein the material unit comprises a cassette pod.

49. (withdrawn) The method of claim 48 wherein the cassette pod comprises a front opening unified pod.

50. (withdrawn) The method of claim 28 wherein the transport equipment is selected from the group consisting of a conveyor and an overhead hoist transport vehicle.

51. (withdrawn) The method of claim 28 wherein the at least one material unit storage location is disposed in a storage unit selected from the group consisting of a stocker and a vertical carousel storage unit.

52. (withdrawn) The method of claim 28 wherein the at least one material unit storage location is disposed on one or more fixed shelves.

53. (currently amended) A method of operating an automated material handling system, comprising the steps of:

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providing one or more storage locations, each storage location for holding one or more material units;

providing transport equipment for moving one or more material units between a plurality of predetermined sites;

providing a material unit transfer assembly for moving one or more material units between the transport equipment and the one or more storage locations, the assembly including a plurality of material unit transfer apparatuses, each material unit transfer apparatus as recited in claim 1, the plurality of material unit transfer apparatuses being arranged side-by-side within a plane defined by first and second orthogonal axes;

moving one or more material units between a first material unit transfer apparatus and the transport equipment or the one or more storage locations along—in a direction of the first axis by a first transfer mechanism included in the first transfer apparatus; and

moving one or more material units between the first transfer apparatus and a second material unit transfer apparatus adjacent the first transfer apparatus within the assembly along—in a direction of the second axis by a second transfer mechanism included in the first transfer apparatus.

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54. (currently amended) The method of claim 53 further including the step of moving one or more material units from the second material unit transfer apparatus to the transport equipment or one or more second storage locations in a direction ~~parallel to~~ of the first axis by a first transfer mechanism included in the second transfer apparatus.

55. (currently amended) The method of claim 53 wherein the first moving step includes extracting one or more material units from one or more first storage locations ~~along in a direction of~~ the first axis for subsequent transfer to a first substantially planar platform included in the first material unit transfer apparatus.

56. (currently amended) The method of claim 55 wherein the second moving step includes moving the one or more material units from the first platform of the first transfer apparatus to a second substantially planar platform included in the second material unit transfer apparatus adjacent the first transfer apparatus ~~along in~~ a direction of the second axis.

57. (currently amended) The method of claim 56 further including the step of moving the one or more material units from the second

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platform of the second transfer apparatus to one or more second storage locations in a direction parallel ~~to~~ of the first axis by a first transfer mechanism included in the second transfer apparatus.

58. (original) The method of claim 53 wherein the material unit comprises a cassette pod.

59. (original) The method of claim 58 wherein the cassette pod comprises a front opening unified pod.

60. (original) The method of claim 53 wherein the transport equipment is selected from the group consisting of a conveyor and an overhead hoist transport vehicle.

61. (original) The method of claim 53 wherein the at least one material unit storage location is disposed in a storage unit selected from the group consisting of a stocker and a vertical carousel storage unit.

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62. (original) The method of claim 53 wherein the at least one material unit storage location is disposed on one or more fixed shelves.

63. (original) The method of claim 53 wherein the transport equipment and each material unit transfer apparatus has at least one location associated therewith for holding at least one material unit, and further including the steps of

detecting the presence of respective material units in each storage location and in each location associated with the transport equipment and the material unit transfer apparatuses by a plurality of sensors,

providing signals indicative of whether a respective material unit is present in each of the locations by the plurality of sensors,

receiving the sensor signals by a controller, and

controlling the movement of the material units based on the received sensor signals by the controller.

64. (original) The method of claim 63 further including the step of maintaining a database indicating whether a respective material unit is present in each storage location and in each location

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associated with the transport equipment and the material unit transfer apparatuses by the controller.

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